Software Matters: The Benefits of Automation on Global Networks

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Software Defined Network



"Software-defined networking (SDN) is an approach to networking that centralizes control of the network by separating the control logic to off-device compute resources. <u>This enables operators to use programmable control to orchestrate and</u> <u>automate network services</u> without having to physically access the network's hardware."

- SDxCentral

Brief history of SDN



- In 2008 a paper describing OpenFlow is published
- In 2012 Google presented to the OpenNetworking Summit about OpenFlow
 - > OpenFlow was a radical departure from traditional networking
 - > Many of the problems Google encountered were about programmatic control of network devices
- Key concepts
 - > Centralized & automated control of the network
 - > API-based control of the network and network elements
 - > Abstracted data models to describe the network

Traditional Network





Software Defined Network





Hybrid SDN





TT's Global IP Network

About the Global IP Network

- The Global IP Network is a division of NTT Ltd., a leading global technology services company that brings together 30+ brands
- The Global IP Network manages a top-ranked IP backbone with 90+ locations worldwide
- The Global IP Network operates with a single autonomous system number globally (AS2914)





The importance of automation in the Global IP Network

IP transit pricing experiences a consistent downward pressure

• Underlying costs must be managed in a similar fashion

Operating expenses are kept low through a large degree of automation

- Minimized peer review
- Lower staffing requirements

This leads to...



- Higher quality of service
 - Lower error rates (especially catastrophic errors)
- Improved service delivery
 - Consistency + Diversification of platforms
 - Speed
- Extensive network visibility



GIN Unified Management System



- Developed in house
- Started in late 1990's at Verio 20+ years of progress!
- Originally developed by the IP engineering staff
- Currently manages 500+ network elements
- Driving fully automated (not autonomous) network configuration
- Development is now done by a dedicated team!

GUMS Architecture





Brute Force Configuration Deployment



- Entire device configurations are generated on the server
- No persistent manual configuration on the devices
- Configurations are pushed to the router via scripts built on RANCID

From Routers to Database Tables



- We were able to abstract our configurations so that they could be moved between platforms seamlessly
- We moved from router configuration commands to database tables
 - We made fewer configuration errors
- We still did not handle concurrent configurations gracefully
- We still had to click through dozens of screens to configure anything moderately complex

From Routers to Database Tables – Enough?



NTT



New GUMS Architecture





Towards Service-based Provisioning



- Old GUMS is organized as a system to mostly edit single objects
 - But network configurations are complex
- New GUMS
 - Newer technologies
 - > We can hire people easily
 - From database tables to service-based provisioning
 - Entire network configurations in single pages
 - > Less clicks, less moving around

A thick client





The UI is an application that runs in the browser. It has knowledge of the domain.





Optical configuration, from device to link



Components



Optical configuration, visual model

Configuration diagram



🕐 NTT

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Optical configuration, a link



Components



Optical configuration, new device



Device name	Create new device	REATE DEVICE
	Select the type of device you want to create. Type Node L100	SAVE
	Select the topology to populate the device with.	
	None 👻	
	CANCEL ADD	

Optical configuration, new device + topology



Device name	Create new device
	Select the type of device you want to create.
	Node L100
	Select the topology to populate the device with.
	standard-2d-roadm
	CANCEL ADD

Optical configuration, almost done...



Components





Lesson Learned



- There must be organizational buy-in
 - Network engineering teams may not adapt to "dev" culture immediately
 - Some organizations/employees may feel their being automated out of a job
 - It requires an investment
- You will need a dedicated team
- There will be custom development work
 - Independently from build or buy
 - There are no "drop-in" solutions
- Don't let the perfect be the enemy of the good!
 - You don't have to do it all at once
- Teams must be aware of "skill rot"



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